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AUTHOR Bellamy, G. Thomas; And Others
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ABSTRACT

The efficiency of training severely retarded adults in sheltered workshops with frequent changes of specific jobs can be increased through an "operations" approach. The approach focuses on teaching workers to respond correctly to cues frequently used in vocational training, such as modeling or priming the response, or providing match to sample cues. The ability to respond correctly to these cues is conceptualized as an "operation" or generalized response class, which if taught, might increase the efficiency of subsequent task training. The approach was successfully used with three severely retarded men who learned the operation of positioning small parts to match samples. Training techniques relied on differential reinforcement, modeling, and priming of responses to items which varied within a defined range of stimulus features. Acquisition of the operation was assessed by measuring responses to untrained and unreinforced probe tasks. (Author/DB)

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G. Thomas Bellamy
Peter R. Oliver
Dorothy D. Oliver

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"Operations" in Vocational Training for the Severely Retarded

G. Thomas Bellamy
University of Oregon
Peter R. Oliver and Dorothy D. Oliver
Fairview Hospital and Training Center, Salem, Oregon

Running Head: Operations

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G. Thomas Bellamy, Ph.D., is Assistant Professor and Director, Specialized Training Program, University of Oregon Center on Human Development. Peter R. Oliver, Ph.D., is Psychologist, Fairview Hospital and Training Center. Dorothy D. Oliver, B.S., is a Research Assistant, Fairview Hospital and Training Center, Salem, Oregon.

Abstract

Severely retarded adults have repeatedly demonstrated their ability to learn difficult vocational skills. Yet, in many sheltered workshops the rapidly changing work and consequent need for frequent retraining may prevent their participation unless training can become more efficient on successive tasks. A possible approach to increasing training efficiency is described which focuses on teaching workers to respond correctly to cues frequently used in vocational training, such as modeling or priming the response, or providing match to sample cues. The ability to respond correctly to these cues is conceptualized as an operation or generalized response class, which if taught, might increase the efficiency of subsequent task training. An illustration is provided in which three severely retarded men learned the operation of positioning small parts to match samples. Training techniques relied on differential reinforcement, modeling and priming of responses to items which varied within a defined range of stimulus features. Acquisition of the operation was assessed by measuring responses to untrained and unreinforced probe tasks. A multiple baseline design across subjects supports the interpretation that the training procedures resulted in acquisition of the defined operation. Future research is proposed to identify efficient methods of teaching this and other operations relevant to vocational training.

"Operations" in Vocational Training for the Severely Retarded

The ability of severely retarded adults to learn a variety of difficult vocational skills is supported by a rapidly expanding research literature (Bellamy, Peterson, & Close, 1975; Crosson, 1966; Gold, 1976; Jacobs, 1976; Martin & Flexer, 1975). In view of these results, it is not surprising that several authors now advocate for the inclusion of more severely retarded persons in sheltered vocational programs (Bellamy, 1976; Fox & Karan, 1976; Gold, 1973). However, the episodic nature of work tasks performed in many sheltered workshops may provide a barrier for prospective severely retarded participants. Contracts are often short-lived, with the result that workers are frequently reassigned from task to task. In this situation, the documented ability of severely retarded adults to learn difficult tasks in individual training does not seem sufficient. Also necessary for productive work is an ability to learn a continuing series of new tasks without expensive training periods for each. Therefore, if severely retarded adults are to participate competitively in these vocational situations, ways must be found to increase the efficiency of training on successive work tasks. The purpose of this paper is to describe and illustrate a set of generalized skills, or operations, which may facilitate vocational training.

Completion of a vocational task essentially involves performance of a sequence or chain of responses with the cue for each step being

provided by characteristics of the task. Teaching this operant chain is typically accomplished through a process of differential reinforcement in which successive approximations to the desired responses are reinforced only in the presence of specific task-related stimuli. To this differential reinforcement process are added a variety of training cues which are intended to augment the task-related discriminative stimuli in order to increase the probability of more acceptable response topographies or discriminations (Bellamy, Inman, & Schwarz, 1976). As a trainee begins to perform independently, these training cues are removed as rapidly as possible, so that the task itself provides the only discriminative stimuli for the work behaviors.

Efficiency of training thus results in part from the trainer's ability to provide training cues which are functional for the trainee, i.e., which alter the probability of the particular trainee's subsequent responses. Trainers may do this in several ways, including providing verbal directions (Gold & Barclay, 1973), modeling the desired response (Loos & Tizard, 1955; Friedenberg & Martin, 1975), physically priming the trainee through the necessary movements (Hunter & Bellamy, 1976), providing match to sample or picture cues (Merwin, 1974; DeBriere, 1976), or changing properties of the task stimuli (Irvin & Bellamy, 1976; Gold, 1972). With severely handicapped trainees, choice of cue type often depends on an assessment of which type actually increases the chance that the individual will respond correctly. Therefore, one approach to increasing the efficiency of vocational

training may be to expand the kind of training cues which are functional for a trainee.

For a training cue to be functional, it must provide a discriminative stimulus which increases the probability that the trainee will perform new responses correctly. The trainee must, therefore, possess a generalized skill of following a particular type of cue with a matching or otherwise appropriate response. A well known example is the generalized imitation skill (Baer, Peterson, & Sherman, 1967) in which trainees imitate new responses for which they received no reinforcement. Becker, Engelmann and Thomas (1971) have labeled this generalized skill an operation. An operation is a set of response characteristics which have a common functional effect and which are under the stimulus control of specific features of a task or setting. Operations are taught by (1) specifying the relevant task and response features; (2) defining the range of situations or tasks in which the operation is to be performed; and (3) teaching tasks which both sample the complete range and provide systematic variation of irrelevant task and response characteristics. Evidence that an operation has been learned is provided when the trainee performs correctly on previously untaught tasks.

The ability of a trainee to match typically used vocational training cues can thus be viewed as an operation which can be taught. To the extent that severely retarded persons have learned the operations of appropriately following such cues as models, physical primes, verbal directions, and match to sample cues, training in vocational skills may become more efficient and participation in community

vocational programs more likely. The purpose of the training illustration presented here was to demonstrate and evaluate a procedure for teaching one such operation, the ability to manipulate small parts to match samples.

Method

Subjects

Three severely retarded residents of the Fairview Hospital and Training Center served as subjects. They were ambulatory with no marked physical or sensory deficits and had been institutionalized for an average of 20 years. Subject 1, Joe, was a 28-year old man with a social age of 3.2 years and a social quotient of 11 as measured by the Vineland Social Maturity Scale (1965). He displayed generalized imitation of both motor and verbal behavior and possessed some receptive and expressive language. Subject 2, Tom, was a 26-year old man with a social age of 3.3 years and a social quotient of 12. He displayed generalized imitation of motor behavior, had a limited receptive-language vocabulary and was nonverbal. Subject 3, Pete, was a 26-year old man with a social age of 3.5 years and a social quotient of 15. He imitated neither motor or verbal behavior, possessed a receptive language vocabulary limited to following simple commands and had some expressive language. All subjects were initially tested to see whether they could perform the sample matching operation. Of the 32 tasks in this pretest, Joe and Pete failed to match any item, while Tom made three correct responses.

Task and Apparatus

Both training and probe tasks required the subject to select an item from a parts bin, place it on a platform so that it matched the position of an identical sample, and then repeat this process with an item in an adjacent bin. The parts bin consisted of two adjacent 7.6-cm. square bins, with 5-cm. vertical walls on three sides. Extending from the open side of each bin, which faced the subject, was a platform with space for placement of both the sample to be matched and the item placed by the subject. A red dot, approximately 1-cm. in diameter, was drawn on the platform in front of each bin to mark where the subject should place each item.

Five sets of small parts items were used to construct training and probe tasks (See Figure 1). Non-discrimination items were flat, circular, and identical on both sides (e.g., washers, poker chips). Up-down items required the subject to discriminate which of two surfaces faced up. Up-down items were narrow in depth to allow placement only on the top and bottom surfaces, and they were round so that rotational discriminations were impossible. Directional items were those which could be matched only with respect to their rotation in a horizontal plane (e.g., a nail with the head pointed toward the subject). Two-dimensional items required the subject to utilize both up-down and directional dimensions in making a correct match. Assembly items consisted of a pair of items that were assembled out of the sight of the subject and placed together as the sample. The subject had to pick up both items from the bin and assemble them so that they

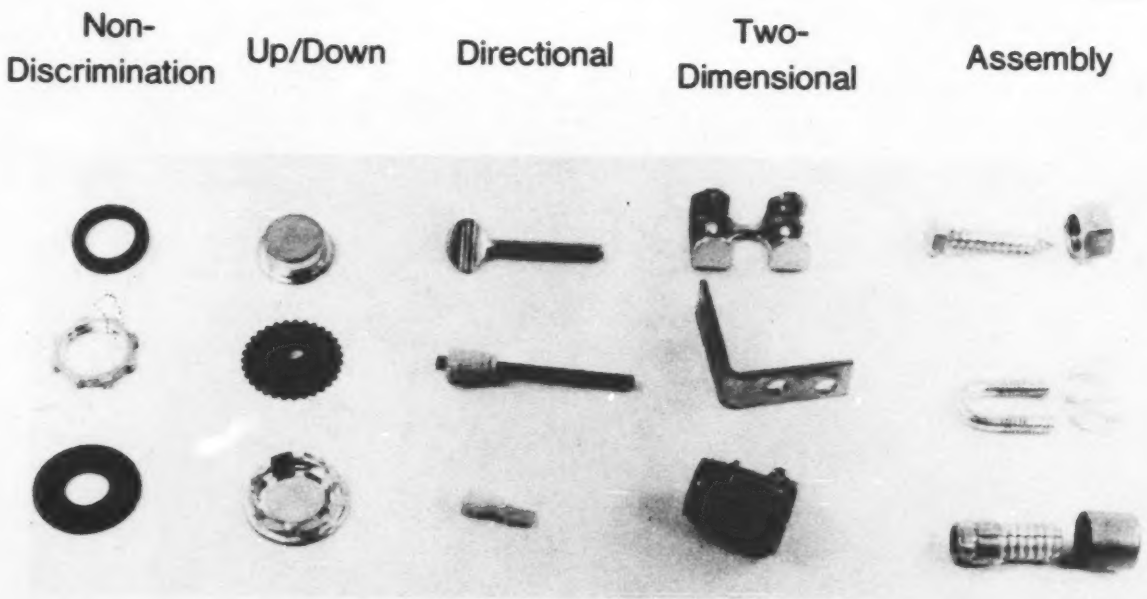

Figure 1
Illustrations of parts used to construct training and probe tasks

matched the preassembled sample. Training tasks and probe tasks were defined using different items from each of the up-down, directional, two-dimensional and assembly sets.

General Training Procedures

Subjects were seen individually during 30- to 40-minute sessions, once daily, approximately three times per week over a 2-month period. An effort was made to provide training for all three subjects on any day that training sessions were conducted. Due to scheduling difficulties, however, there were some instances in which only one or two subjects were trained on a given day. Sessions were conducted in an upstairs dormitory room away from the living area. The experimenter and subject sat beside each other at a small table upon which the bin apparatus was placed.

A task was presented with the instruction, "(name), make it look like this," with the experimenter pointing to the sample in front of the left-hand bin. If the subject responded correctly, he was praised and then given the same instruction with a gesture to the right-hand bin. When both items had been correctly positioned, the subject was reinforced with both praise and edible treats. Responses to initial tasks of a session were reinforced on a continuous basis. This was faded to an intermittent schedule after the subject was generally attending and performing correctly.

If the subject incorrectly positioned an item and/or failed to place it in front of the corresponding sample, the correct response was modeled several times along with a verbal statement concerning

the salient features of the sample. The subject was then given another opportunity to respond. Subsequent errors were corrected by returning the item to the bin and physically guiding the subject in positioning the item correctly.

Non-Discrimination Training

Subjects were first trained to match the position of non-discrimination items. In this phase the subject correctly matched the position of the sample simply by placing the item on the platform. Non-discrimination training served to familiarize the subject with the procedure of selecting an item and placing it on the correct dot and as a baseline control for subsequent training procedures. An item remained in the same bin and in the same position for four or five consecutive trials after which it was removed and replaced with another item. The next time that item was presented it was placed in the opposite bin.

Discrimination Training

Following a multiple baseline design across subjects, training on the sample-matching operation with the up-down items was provided first to Joe, then Tom, and finally Pete. Training procedures were like those used with nondiscrimination items, with the subject responding alternately to the two tasks in the bin setup. Each task remained in the bin for six responses or until the subject correctly matched the sample three consecutive times. The item was then replaced by another task, and was later used again with the sample positioned differently.

After the first five training sessions it appeared to the experimenter that these procedures could be teaching two unwanted operations which were incompatible with the sample matching response. First, Joe appeared to be responding to some items as if a particular side always went up, regardless of changes in the position of the sample. The procedures were therefore changed to allow more frequent changes in the position of each sample and more frequent alternation among tasks. The subject was then asked to respond only once to each item before it was replaced or the position of its sample changed.

A second incompatible operation appeared to result from the position of items in the bins before each response. During initial training sessions, the item was placed in the bin so that some rotation was necessary to match the position of the sample. After several responses, subjects began turning many of the items over before placing them on the dot, regardless of the sample position, presumably because this had led to a correct match on previous tasks. Thus, the experimenter began randomizing the position of the item in the bin so that it was the same as the sample on approximately half the trials and in the opposite position on the remaining trials. This appeared to be successful in overcoming the competing operation of simply "flipping" each item. Both procedural changes were simultaneously incorporated into the nondiscrimination training procedure for subjects 2 and 3.

Probe Procedures

Acquisition of the sample matching operation within the stimulus range defined by each set of items was assessed by measuring performance on untrained and non-reinforced (probe) tasks. Thirty-two probe tasks were constructed, eight each from the up-down, direction, two-dimensional and assembly sets. The position of each sample was randomly determined before each probe sequence.

Probe items were first presented during a pretesting session. Thereafter, all were presented near the end of each training session by randomly interspersing them among the trained items. Subjects continued to be reinforced for correctly matching the trained items but no reinforcement was given for correctly matching a probe item. On some occasions up to four probes occured successively, thereby reducing the reinforcement density. At these times the subject was praised for paying attention and remaining seated after the items had been removed from the bin setup and just prior to the introduction of a new pair of items.

A task was scored as correct if the required matching response occured within 10 seconds of the direction, "(name), make it look like this." Matching responses were correct if the appropriate surface of an up-down item was visible; if the rotation of a directional item differed less than 20^{0} from the sample; if a two-dimensional item met the criteria for both up-down and rotational items; and if assembly items were put together in exactly the same manner as the sample.

Once during each phase, an additional observer independently recorded each subject's responses to all 32 probe tasks. In every case agreement between the two observers was perfect, reflecting the ease of recording matching responses.

Additional Training Phases

Discrimination training on the up-down items continued until each subject acquired a sample matching operation across some item sets. When the operation was restricted to items similar to those being reinforced during training, or to some other subset of probe items, the subject was trained to match additional classes of items. This training began with directional items and continued until the operation was performed correctly across the entire range of probe tasks. To maintain correct responding on previously taught sets of tasks, items not used in probes were occasionally presented and correct responding reinforced.

Results

Probe data for each subject are presented in Figure 2. Each point represents the total number of correct probe responses within each set. The vertical dotted line that bisects every subject's data indicates when the experimenter began changing the position and bin placement of the sample on each trial. The solid triangles at the bottom of each graph represent days when training did not occur for that subject.

During non-discrimination training, the number of correct probe responses remained at pretest levels. Joe did not correctly match

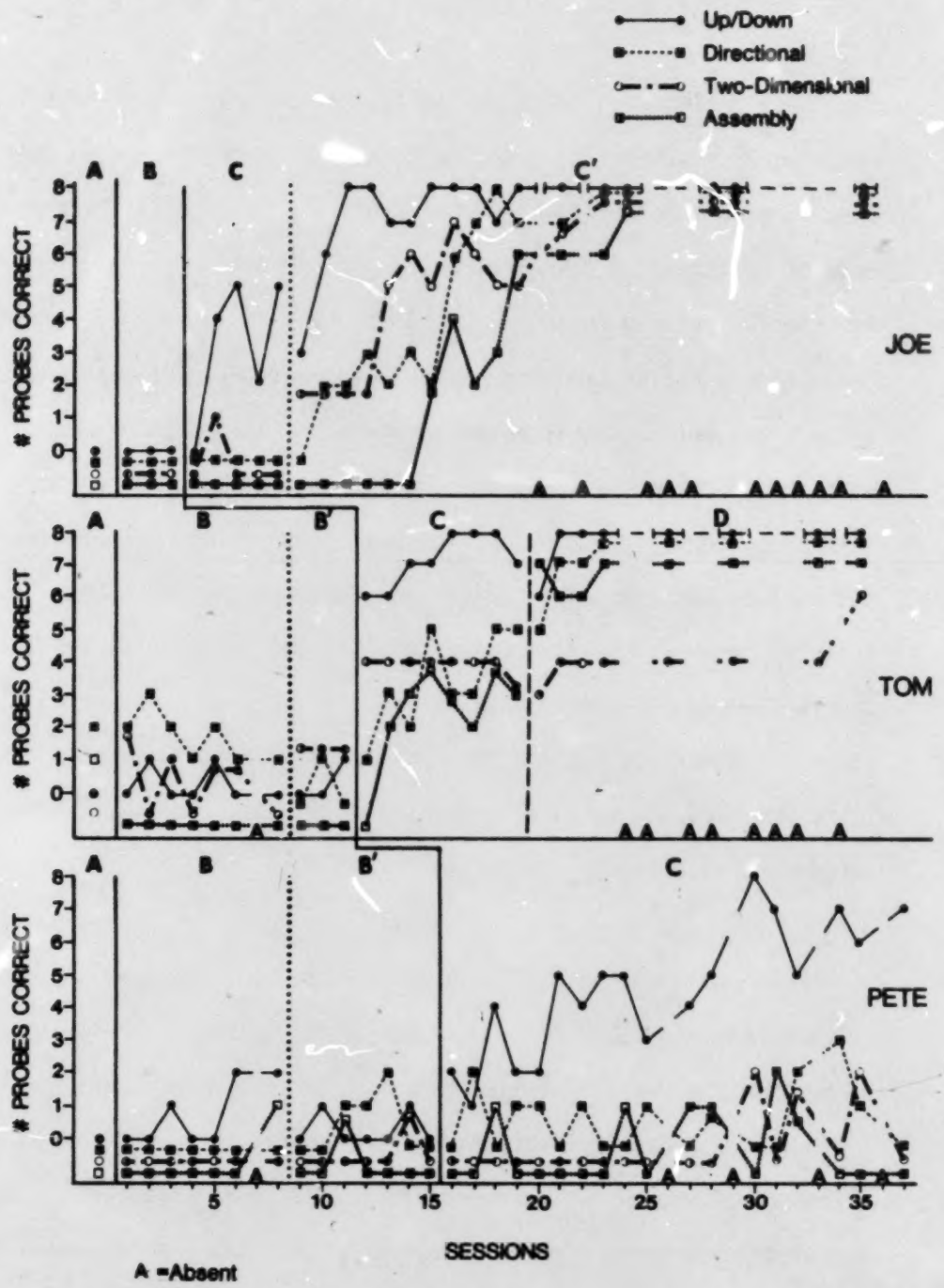

Figure 2

Number of correct responses to probes conducted during (A) pretest; (B) training on non-discrimination tasks, (C) training on up-down tasks; and (D) training on directional tasks. Probes conducted after training procedures were revised are marked B' and C'.

any of the probes. Tom and Pete matched several probes but their performance was inconsistent. With the introduction of up-down discrimination training, where the sample remained constant over several responses, Joe began matching several of the up/down probes but very few of the probes within the remaining sets. His performance, however, appeared to be one of randomly "flipping" some items but not others thereby leading to some correct responses. When discrimination training procedures were revised so that the position and bin placement of the sample was changed after each response, Joe began matching probes within all four probe classes. After 13 training sessions, Joe correctly matched all 32 probes and maintained this level of performance over the next four sessions.

Even though the samples were changed after each response in non-discrimination training, Tom and Pete showed no comparable change in performance until up-down discrimination training was introduced. With the introduction of the revised discrimination training procedures, Tom also displayed an immediate increase in correct probe responses. Unlike Joe, however, generalization of matching responses appeared more restricted to the class of probes containing items similar to those being concurrently trained. After five sessions, Tom correctly matched all eight of the up-down probes on all subsequent training sessions except two. When only up-down items were being trained, the average number of correct responses on directional, 2-dimensional and assembly probes was 3.38, 3.88 and 2.62, respectively. When training on directional items was introduced, and a maintenance

procedures applied to previously learned up-down items, Tom displayed an immediate increase in correct matching of both directional and assembly probes. The number of 2-dimensional probes correctly matched remained the same until the last training session at which time Tom matched 6 of the 8 probes within this class.

When discrimination training began for Pete, some generalized matching was observed for up-down probes alone. During non-discrimination training, Pete correctly matched an average of 0.47 up-down probes. This average increased to 4.50 over 18 training sessions. Little generalization occurred across the remaining probe classes. Subsequent training for Pete did not take place due to increasing belligerence and refusal to accompany the experimenter into the training area. This was interpreted as behavioral evidence that informed consent was being withdrawn, and the training program was terminated.

Discussion

The results from the first two trainees provide evidence that the ability to follow a typically used vocational training cue is an operation which can be taught to severely retarded adults. Furthermore, the development of this operation was functionally related to the specific training procedures used. Generalization of matching responses to untrained and unreinforced probes only occured after trainees were required to respond to the stimulus configuration of the sample's position on the platform by emitting whatever manipulations were necessary to match that position. Other stimulus and response characteristics of the task, such as the bin setup and the actions of selecting an item from the bin and placing it

on the platform, were not functional in developing the operation since they were all present in non-discrimination training.

Although the teaching procedures described here were effective in developing the sample-matching operation, a question still remains as to the most efficient method of teaching this, and perhaps similar, operations. As was noted above, the procedure was modified in the present study because of the experimenter's hypothesis that more rapid acquisition might be obtained if the tasks were changed more frequently and the items positioned in the bins in a random fashion. Of course, no data are available here to evaluate whether this change did result in more rapid acquisition. Continued research is needed to evaluate the relative efficiency of these and other procedural variations.

Future research should also focus on the effects which various training procedures have on the range of resulting operations. As in generalized imitation, some procedures may produce operations which are performed only in response to a limited range of controlling stimuli (Garcia, Baer, & Firestone, 1971). It would appear that vocational training on new and changing tasks would be more efficient if a wide range of potential training cues functioned as discriminative stimuli for a particular operation. In the present study teaching the operation with one class of cues was sufficient to establish the operation across other, quite diverse, classes of cues for one of the trainees, but it was insufficient for the other two. Research is needed that will identify the optimum characteristics of training stimuli which will establish operations that are controlled by the full range of potential training cues.

Also clearly needed is research which assesses the extent to which teaching operations like that illustrated here in fact increases the overall efficiency of vocational training on several tasks. If empirical support is provided for the rationale presented here, several practical implications for prevocational training and work adjustment programs could result. Considerable emphasis has been placed on the teaching of "generalized work skills" in these programs, with typical concern for such behaviors as promptness, attending to task, and use of time cards which are presumed to generalize across tasks and work settings. The operations of correctly following typical training cues may be another important kind of generalized work skill.

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